

Trends in Irrigated Area in India: 1950-51 to 2002-03

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Coverage

- **Main focus:** trends in irrigated area in India & across states from 1950-1 to 2002-3
- Relating ultimate irrigation potential with potential created – All India & States
- Expansion of irrigation by source, NIA & GIA – All India
- Trends in share of irrigated area by source – All India
- Growth in irrigated area by source – All India
- Statewise trends in NIA and GIA
- Statewise trends in irrigated area by source
- Statewise growth in irrigated area by source
- Irrigation development and cropping intensity nexus

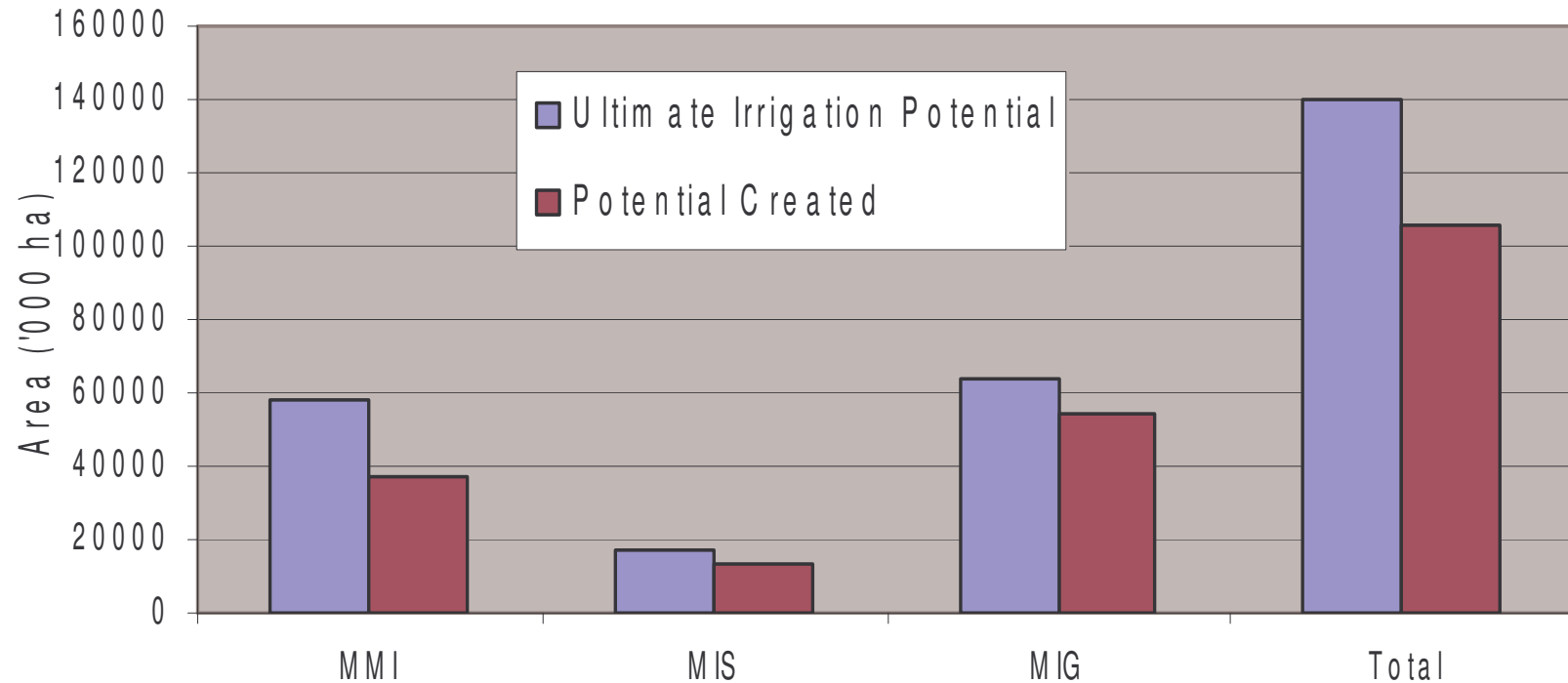
Ultimate Irrigation Potential and Potential Created up to 2002

- How much is the total Irrigation Potential?
- How much potential is created so far?

Irrigation Potential & Utilisation upto 2000-02

| Source | Ultimate Irrigation Potential | Potential Created (mha) | (3)/(2)*100 |
|--|-------------------------------------|-------------------------------|-------------|
| (1) | (2) | (3) | (4) |
| MMI (Major & Medium Irrigation: >2000 ha) | 58.47 (41.76) | 37.05 | 63.37 |
| MI-Surface (< 2000 ha) | 17.37 (12.41) | 13.66 | 78.64 |
| MI-Groundwater | 64.17 (45.84) | 54.61 | 85.10 |
| MI-Total | 81.54 (58.24) | 68.27 | 83.73 |
| All Total (MMI + MI) | 140.00 | 105.32 | 75.23 |

U ltim ate Irrigation P otential and P otential C reated in India: U pto 2002



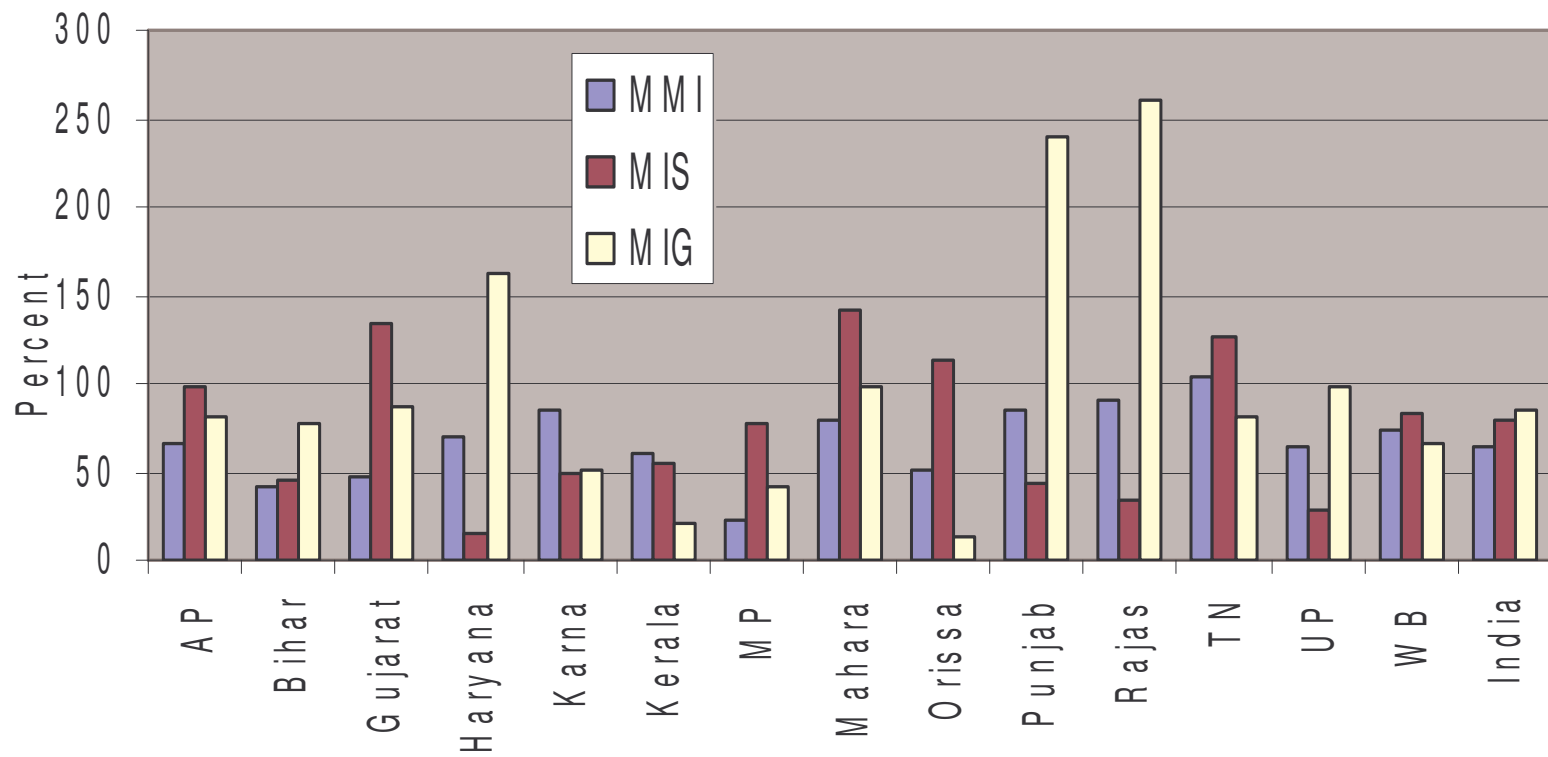
Irrigation Potential and Potential Created: State Level

- Is the irrigation potential same across states?
- Who used more and who used less?

Statewise Ultimate Irrigation Potential (UIP) and Potential Created (PC) in India

| States | Ultimate Irrigation Potential | | | % of PC to UIP | | |
|-------------|-------------------------------|-------|-------|----------------|--------|--------|
| | MMI | MIS | MIG | MMI | MIS | MIG |
| AP | 5000 | 2300 | 3960 | 66.06 | 97.61 | 80.61 |
| Bihar | 6500 | 1900 | 4947 | 41.23 | 46.16 | 78.15 |
| Gujarat | 3000 | 347 | 2756 | 47.67 | 134.87 | 87.59 |
| Haryana | 3000 | 50 | 1462 | 69.97 | 15.40 | 161.90 |
| Karnataka | 2500 | 900 | 2574 | 84.84 | 48.33 | 51.24 |
| MP | 6000 | 2200 | 9732 | 23.12 | 78.00 | 41.45 |
| Maharashtra | 4100 | 1200 | 3652 | 79.00 | 141.17 | 97.37 |
| Orissa | 3600 | 1000 | 4203 | 50.75 | 113.80 | 12.80 |
| Punjab | 3000 | 50 | 2917 | 84.73 | 44.00 | 238.74 |
| Rajasthan | 2750 | 600 | 1778 | 90.25 | 34.83 | 260.46 |
| TN | 1500 | 1200 | 2832 | 103.27 | 127.00 | 81.89 |
| UP | 12500 | 1200 | 16799 | 63.28 | 28.75 | 97.51 |
| WB | 2300 | 1300 | 3318 | 73.17 | 83.62 | 66.49 |
| India | 58465 | 17372 | 44171 | 63.36 | 78.64 | 85.10 |

State wise % of Potential Created to Ultimate Irrigation Potential



Trends in irrigated area by source

- Is the trend in irrigated area same across sources over the last 52 years?
- Which is the source gaining and losing in terms of area?
- What is the trend in share of irrigated area?
- Groundwater and tank irrigation nexus

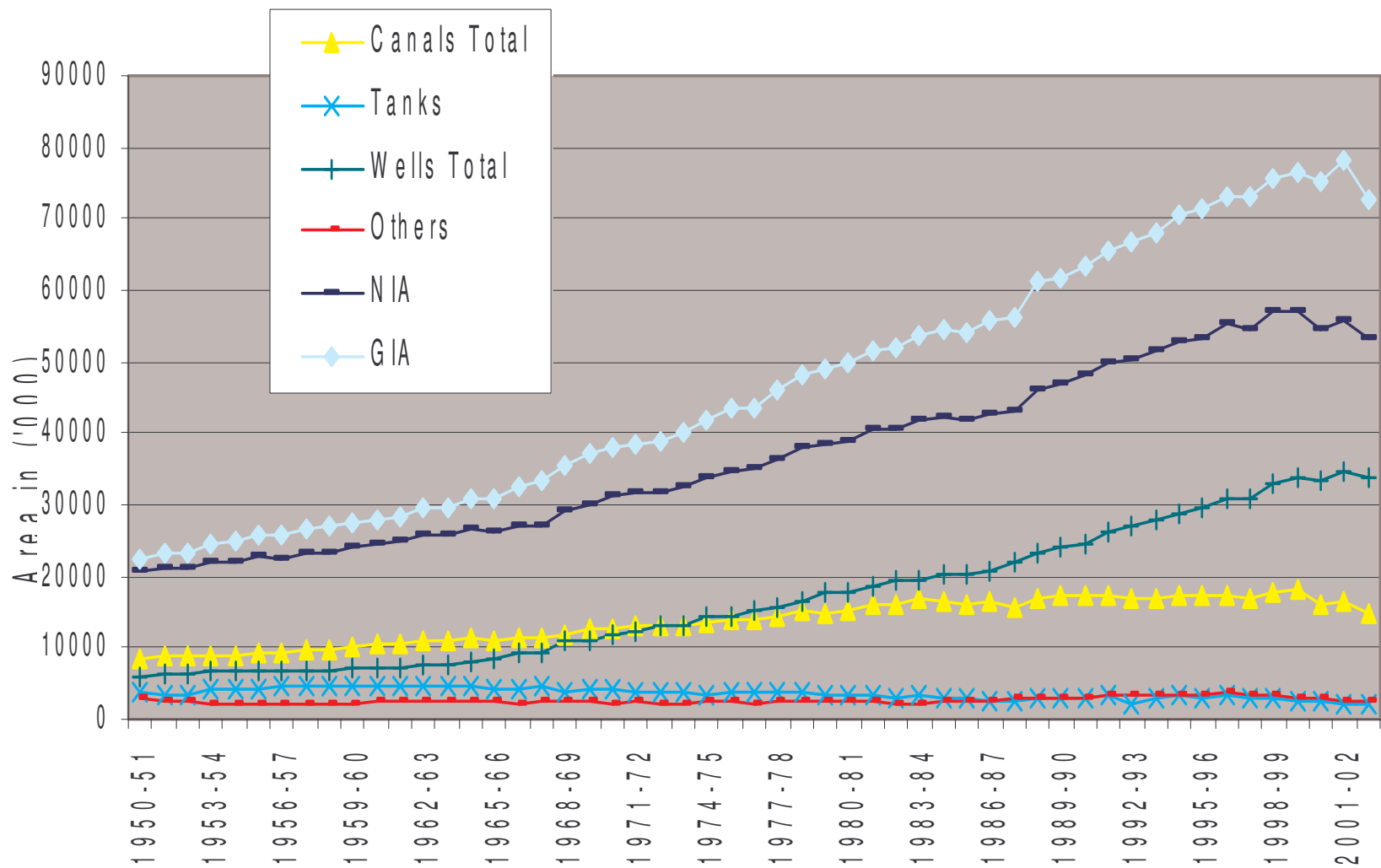
Expansion of Irrigated Area in India (mha)

| Year | Canal | Tank | GW | Others | NIA | GIA |
|--------|-------|------|-------|--------|-------|-------|
| 1950-1 | 8.30 | 3.61 | 5.98 | 2.97 | 20.58 | 22.56 |
| 1960-1 | 10.37 | 4.56 | 7.29 | 2.44 | 24.66 | 27.98 |
| 1970-1 | 12.84 | 4.11 | 11.89 | 2.27 | 31.10 | 38.20 |
| 1980-1 | 15.29 | 3.18 | 17.70 | 2.55 | 37.72 | 49.78 |
| 1990-1 | 17.45 | 2.94 | 24.70 | 2.93 | 48.02 | 63.20 |
| 2002-3 | 16.34 | 2.29 | 34.50 | 2.73 | 55.85 | 78.33 |

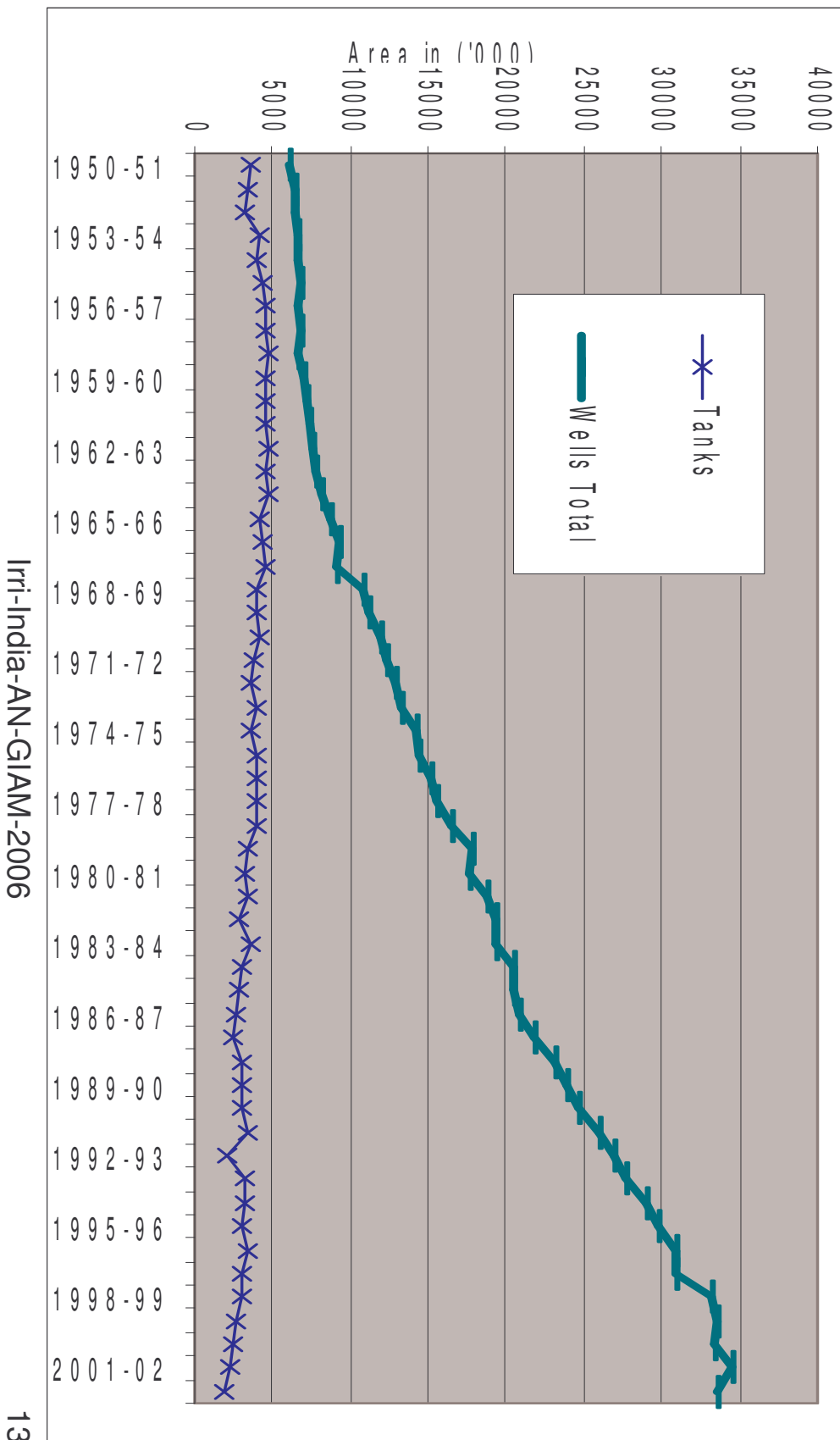
Source-wise Share (%) of Irrigated Area: India

| Year | Canal | Tank | GW | Others | NIA/NSA | GIA/GCA |
|--------|-------|-------|-------|--------|---------|---------|
| 1950-1 | 40.30 | 17.55 | 29.04 | 14.41 | 17.63 | 17.40 |
| 1960-1 | 42.05 | 18.49 | 29.56 | 9.89 | 18.51 | 18.30 |
| 1970-1 | 41.28 | 13.22 | 38.22 | 7.29 | 22.08 | 23.04 |
| 1980-1 | 39.49 | 8.22 | 45.70 | 6.59 | 27.60 | 28.83 |
| 1990-1 | 36.34 | 6.13 | 51.42 | 6.11 | 33.71 | 34.03 |
| 2002-3 | 29.25 | 4.10 | 61.77 | 4.88 | 40.01 | 41.24 |

Trends in Irrigated Area by Source: All India



Tank Vs Groundwater Irrigation in India



Irrigation-India-AN-GIAM-2006

Growth in irrigated area: All India

- From 1950-1 to 2002-3
- Pre-Green revolution period (1950-1 to 1965-6)
- Post-Green revolution period (1965-6 to 2002-3)
- Green revolution period – Phase I (1965-6 to 1980-1)
- Green revolution period – phase II (1980-1 to 2002-3)

Growth of Irrigated Area in India by Source: Various Periods

| | 1950-1 to 1965-6 | 1965-6 to 1980-81 | 1980-1 to 2002-3 | 1965-6 to 2002-3 | 1950-1 to 2002-3 |
|---------|---------------------|----------------------|---------------------|---------------------|---------------------|
| Canal | 1.99 | 2.17 | 0.20 | 1.12 | 1.48 |
| Tank | 1.85 | -1.40 | -1.02ns | -1.49ns | 1.13 |
| T.Wells | -- | 12.21 | 3.94 | 6.22 | 8.55 |
| GWA | 1.87 | 4.81 | 3.22 | 3.68 | 3.74 |
| Others | 0.09ns | 0.58 | 1.31 | 1.11 | 0.67 |
| NIA | 1.72 | 2.65 | 1.82 | 2.12 | 2.12 |
| GIA | 2.11 | 3.09 | 2.13 | 2.47 | 2.55 |
| GIA/GCA | 0.93 | 2.44 | 1.74 | 1.97 | 1.94 |
| NIA/NSA | 0.83 | 2.46 | 1.84 | 2.07 | 1.90 |

Note: Except values with NS (not significant), all others are significant either at 1 or 5 or 10 percent level.

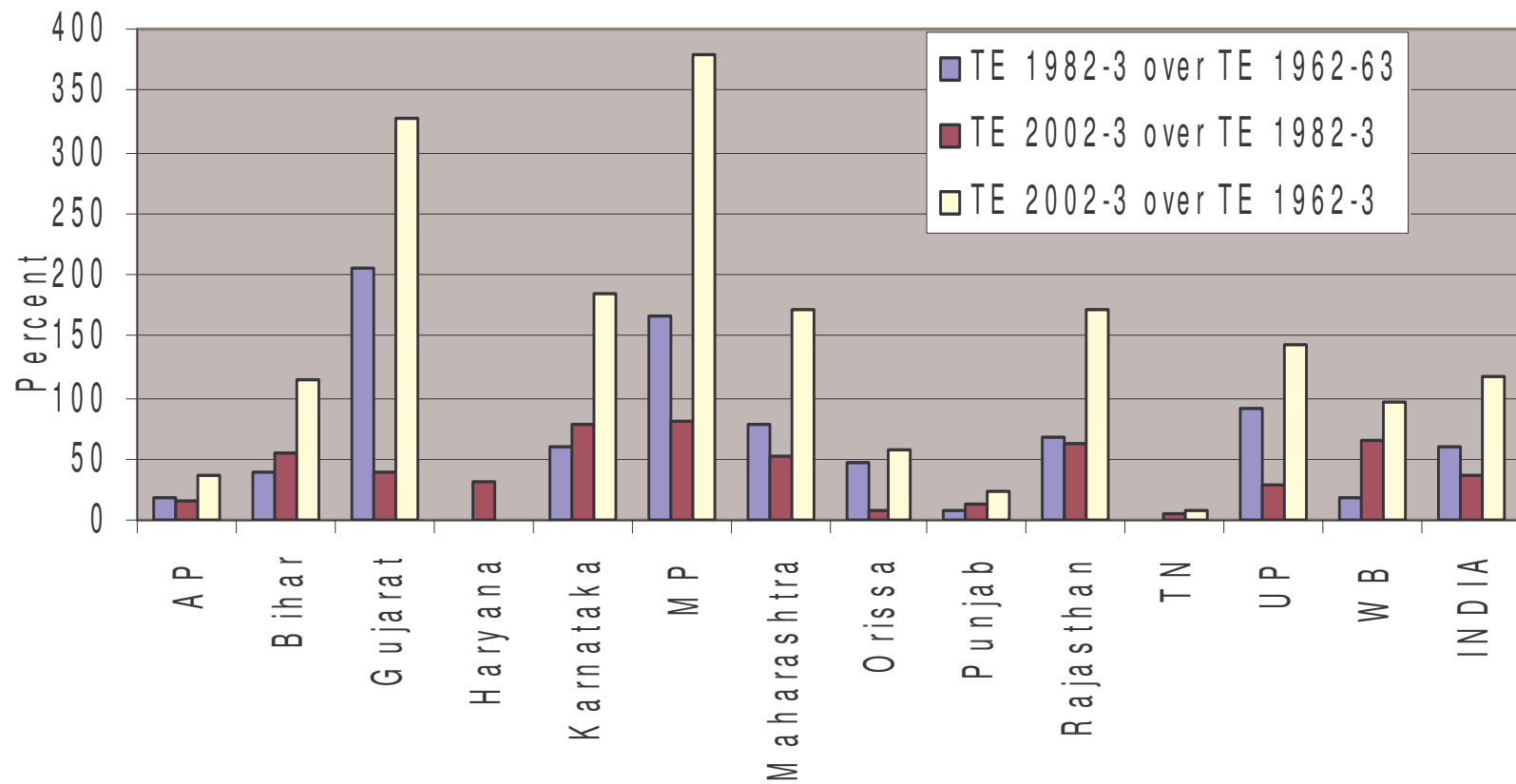
State-wise trends in Irrigated Area

- 14 major states are considered for analysis
- Expansion in NIA and GIA
- Expansion in tank, canal and groundwater irrigated area

State-wise Net Irrigated Area: TE 1962-3 to TE 2002-3

| State | NIA ('000 ha) | | | %Change | | |
|----------------|---------------|---------------|---------------|-------------|-------------|-------------|
| | TE 1962-63 | TE 1982-83 | TE 2002-03 | 2 over 1 | 3 over 2 | 3 over 1 |
| Andhra Pradesh | 3040 | 3560 | 4127 | 17 | 16 | 36 |
| Bihar | 1996 | 2758 | 4256 | 38 | 54 | 113 |
| Gujarat | 700 | 2133 | 2989 | 20 | 40 | 327 |
| Haryana | -- | 2246 | 2954 | -- | 32 | -- |
| Karnataka | 906 | 1439 | 2574 | 59 | 79 | 184 |
| Kerala | 328 | 245 | 379 | -25 | 55 | 16 |
| Madhya Pradesh | 930 | 2470 | 4455 | 165 | 80 | 379 |
| Maharashtra | 1093 | 1954 | 2968 | 79 | 52 | 172 |
| Orissa | 977 | 1425 | 1524 | 46 | 6.95 | 56 |
| Punjab | 3191 | 3447 | 3899 | 8 | 13 | 22 |
| Rajasthan | 1811 | 3035 | 4900 | 68 | 61 | 171 |
| Tamil Nadu | 2491 | 2511 | 2666 | 0.80 | 6 | 7 |
| Uttar Pradesh | 5072 | 9626 | 12338 | 90 | 28 | 143 |
| West Bengal | 1413 | 1669 | 2771 | 18 | 66 | 96 |
| INDIA | 25070 | 39857 | 54555 | 59 | 37 | 117 |

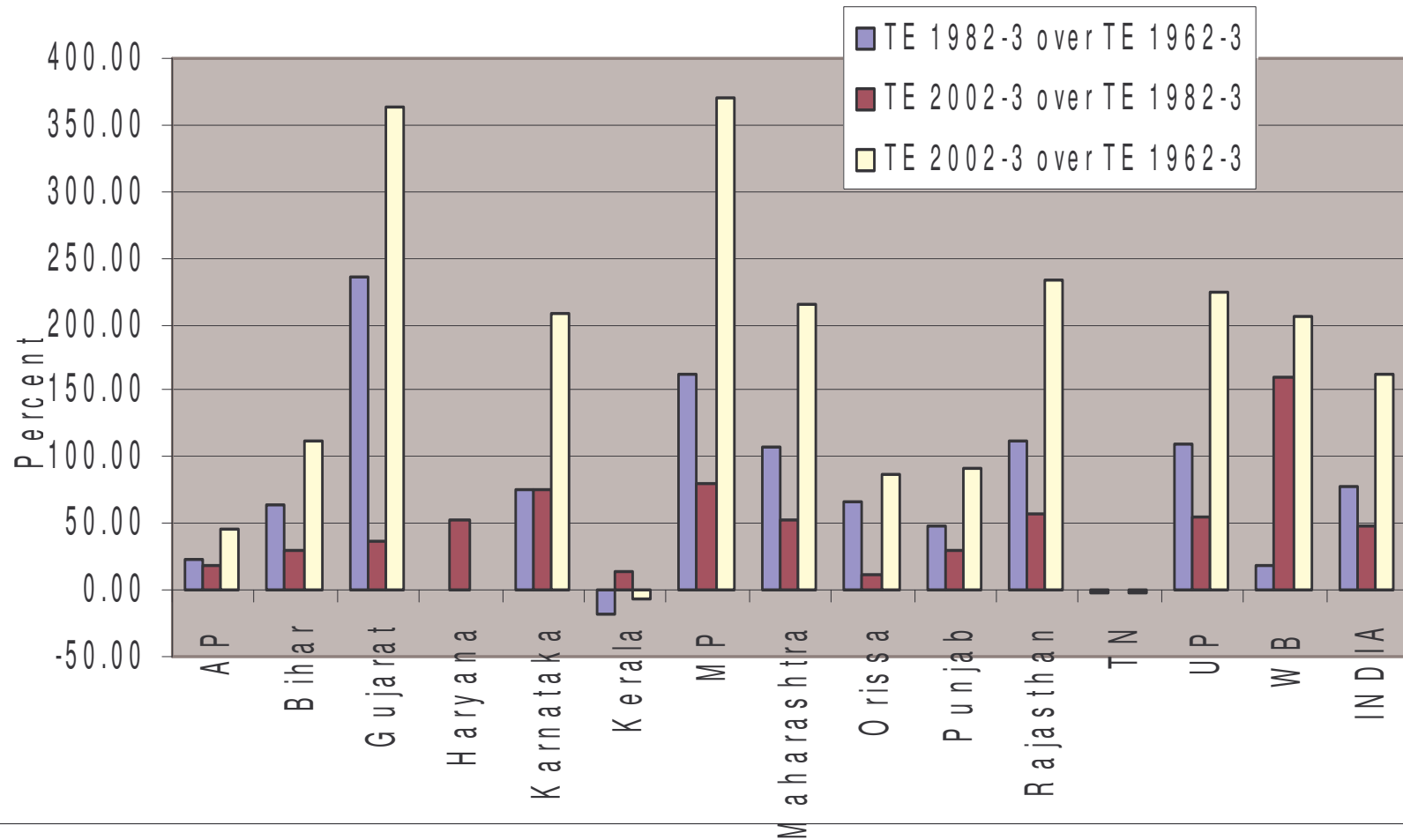
Statewise % Change in NIA



State-wise Gross Irrigated Area: TE 1962-3 to TE 2002-3

| State | GIA ('000 ha) | | | %Change | | |
|----------------|---------------|------------|------------|----------|----------|----------|
| | TE 1962-63 | TE 1982-83 | TE 2002-03 | 2 over 1 | 3 over 2 | 3 over 1 |
| Andhra Pradesh | 3666 | 4513 | 5334 | 23.10 | 18.19 | 45.50 |
| Assam | 611 | 572 | 219 | -6.38 | -61.71 | -64.16 |
| Bihar | 2151 | 3521 | 4550 | 63.69 | 29.22 | 111.53 |
| Gujarat | 740 | 2490 | 3432 | 236.49 | 37.83 | 363.78 |
| Haryana | -- | 3441 | 5244 | -- | 52.40 | -- |
| Karnataka | 997 | 1756 | 3067 | 76.13 | 74.66 | 207.62 |
| Kerala | 466 | 385 | 440 | -17.38 | 14.29 | -5.58 |
| Madhya Pradesh | 978 | 2569 | 4605 | 162.68 | 79.25 | 370.86 |
| Maharashtra | 1244 | 2578 | 3929 | 107.23 | 52.40 | 215.84 |
| Orissa | 1141 | 1908 | 2128 | 67.22 | 11.53 | 86.50 |
| Punjab | 4039 | 5965 | 7772 | 47.69 | 30.29 | 92.42 |
| Rajasthan | 1811 | 3853 | 6050 | 112.76 | 57.02 | 234.07 |
| Tamil Nadu | 3249 | 3150 | 3175 | -3.05 | 0.79 | -2.28 |
| Uttar Pradesh | 5561 | 11705 | 18024 | 110.48 | 53.99 | 224.11 |
| West Bengal | 1444 | 1703 | 4421 | 17.94 | 159.60 | 206.16 |
| INDIA | 28631 | 51053 | 75348 | 78.31 | 47.59 | 163.17 |

State wise % Change in GIA

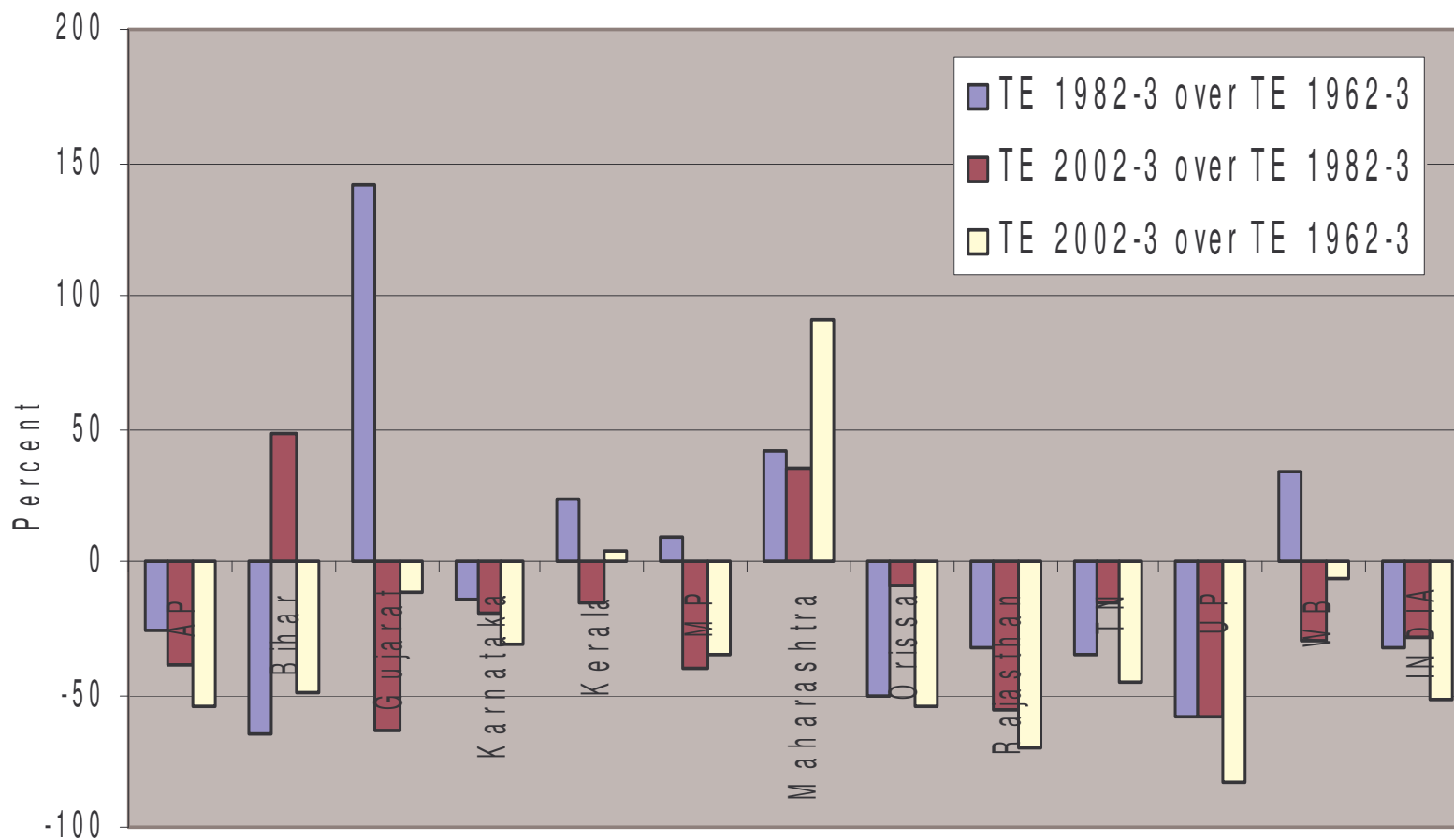


Statewise Tank Irrigated Area: TE 1962-3 to TE 2002-3

| State | TIA (000 ha) | | | %Change | | |
|----------------|--------------|------------|------------|----------|----------|---------|
| | TE 1962-63 | TE 1982-83 | TE 2002-03 | 2 over 1 | 3 over 2 | 3 and 1 |
| Andhra Pradesh | 1266 | 933 | 574 | -26.30 | -38.48 | -54.66 |
| Bihar | 279 | 97 | 143 | -65.23 | 47.42 | -48.75 |
| Gujarat | 17 | 41 | 15 | 141.18 | -63.41 | -11.76 |
| Haryana | | 0.3 | 1 | | | |
| Karnataka | 358 | 306 | 248 | -14.53 | -18.95 | -30.73 |
| Kerala | 48 | 59 | 50 | 22.92 | -15.25 | 4.17 |
| Madhya Pradesh | 140 | 152 | 91 | 8.57 | -40.13 | -35.00 |
| Maharashtra | 193 | 273 | 369 | 41.45 | 35.16 | 91.19 |
| Orissa | 495 | 243 | 222 | -50.91 | -8.64 | -55.15 |
| Punjab | 6 | | | | | |
| Rajasthan | 167 | 113 | 50 | -32.34 | -55.75 | -70.06 |
| Tamil Nadu | 941 | 615 | 516 | -34.64 | -16.10 | -45.16 |
| Uttar Pradesh | 418 | 173 | 72 | -58.61 | -58.38 | -82.78 |
| West Bengal | 34 | 313 | 220 | 820.59 | -29.71 | 547.06 |
| INDIA | 4651 | 3143 | 2261 | -32.42 | -28.06 | -51.39 |

Irrigation in India - ANGIAM-2006

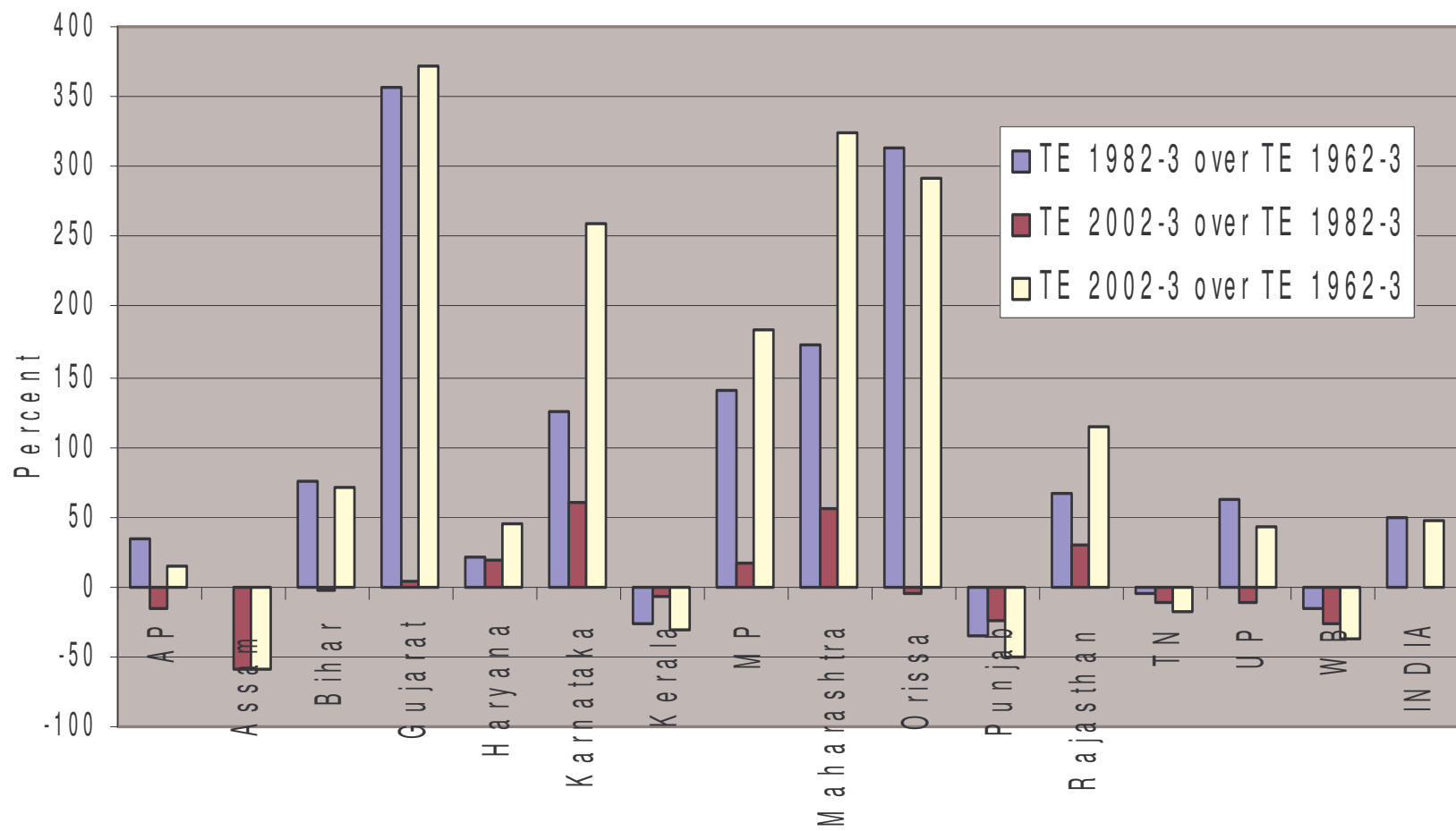
State wise % Change in Tank Irrigated Area



Statewise Canal Irrigated Area: TE 1962-3 to TE 2002-3

| State | CIA (000 ha) | | | %Change | | |
|----------------|---------------|---------------|---------------|----------|----------|---------|
| | TE 1962-63 | TE 1982-83 | TE 2002-03 | 2 over 1 | 3 over 2 | 3 and 1 |
| Andhra Pradesh | 1294 | 1731 | 1473 | 33.77 | -14.90 | 13.83 |
| Bihar | 603 | 1059 | 1028 | 75.62 | -2.93 | 70.48 |
| Gujarat | 89 | 406 | 419 | 356.18 | 3.20 | 370.79 |
| Haryana | 991 | 1202 | 1443 | 21.29 | 20.05 | 45.61 |
| Karnataka | 256 | 577 | 918 | 125.39 | 59.10 | 258.59 |
| Kerala | 146 | 107 | 100 | -26.71 | -6.54 | -31.51 |
| Madhya Pradesh | 453 | 1093 | 1282 | 141.28 | 17.29 | 183.00 |
| Maharashtra | 247 | 671 | 1047 | 171.66 | 56.04 | 323.89 |
| Orissa | 225 | 930 | 880 | 313.33 | -5.38 | 291.11 |
| Punjab | 2153 | 1405 | 1073 | -34.74 | -23.63 | -50.16 |
| Rajasthan | 586 | 971 | 1255 | 65.70 | 29.25 | 114.16 |
| Tamil Nadu | 903 | 851 | 749 | -5.76 | -11.99 | -17.05 |
| Uttar Pradesh | 2004 | 3236 | 2884 | 61.48 | -10.88 | 43.91 |
| West Bengal | 886 | 756 | 560 | -14.67 | -25.93 | -36.79 |
| INDIA | 10568 | 15724 | 15616 | 48.79 | -0.69 | 47.77 |

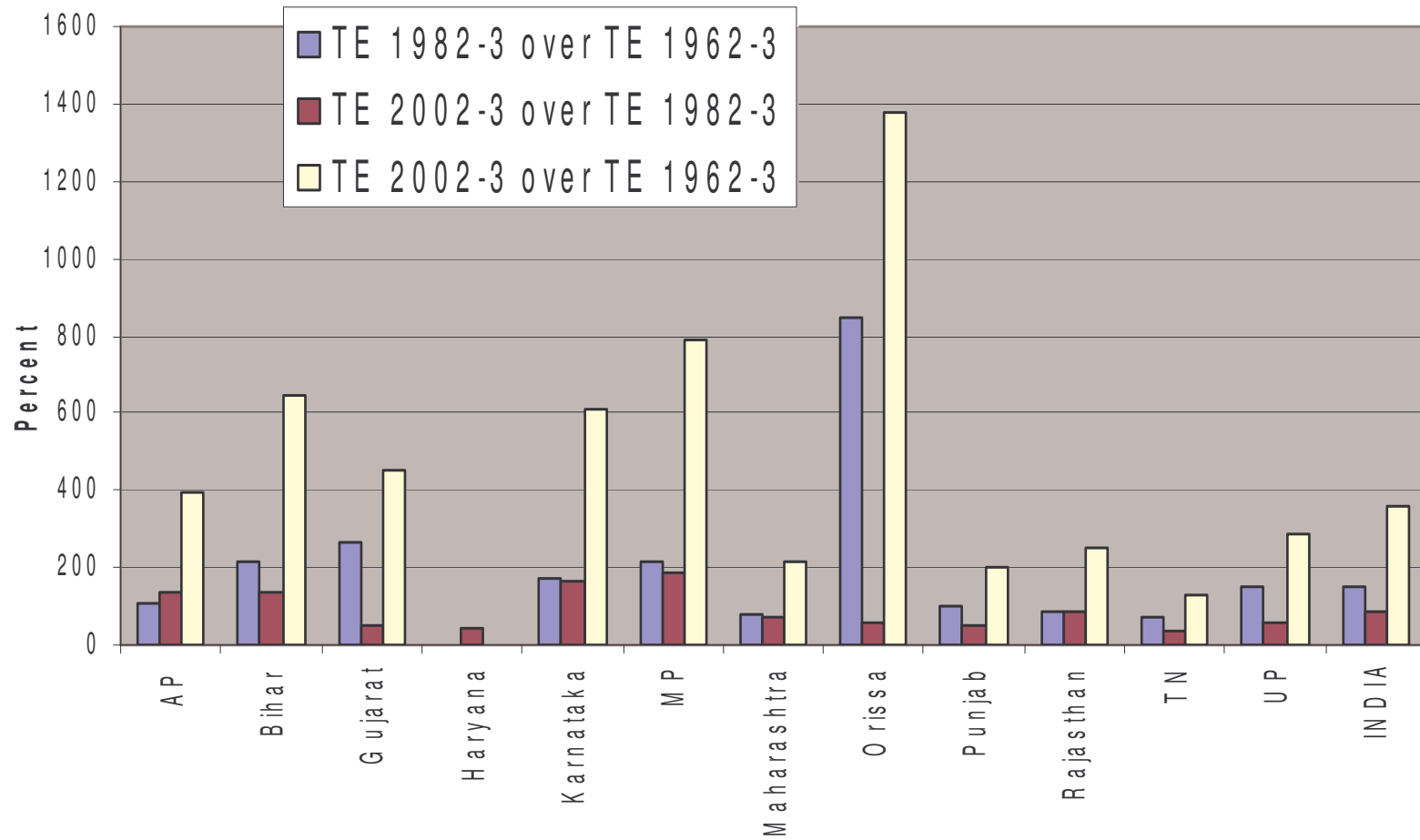
Statewise % Change in Canal Irrigated Area



Statewise Groundwater Irrigated Area: TE 1962-3 to TE 2002-3

| State | CIA (000 ha) | | | %Change | | |
|----------------|---------------|---------------|---------------|----------|----------|---------|
| | TE 1962-63 | TE 1982-83 | TE 2002-03 | 2 over 1 | 3 over 2 | 3 and 1 |
| Andhra Pradesh | 388 | 800 | 1908 | 106.19 | 138.50 | 391.75 |
| Bihar | 299 | 949 | 2224 | 217.39 | 134.35 | 643.81 |
| Gujarat | 463 | 1681 | 2544 | 263.07 | 51.34 | 449.46 |
| Haryana | -- | 1038 | 1497 | | 44.22 | |
| Karnataka | 146 | 395 | 1035 | 170.55 | 162.03 | 608.90 |
| Kerala | 2 | 44 | 116 | 2100.00 | 163.64 | 5700.00 |
| Madhya Pradesh | 332 | 1037 | 2958 | 212.35 | 185.25 | 790.96 |
| Maharashtra | 613 | 1111 | 1922 | 81.24 | 73.00 | 213.54 |
| Orissa | 38 | 361 | 561 | 850.00 | 55.40 | 1376.32 |
| Punjab | 999 | 2031 | 3009 | 103.30 | 48.15 | 201.20 |
| Rajasthan | 1019 | 1899 | 3555 | 86.36 | 87.20 | 248.87 |
| Tamil Nadu | 602 | 1023 | 1387 | 69.93 | 35.58 | 130.40 |
| Uttar Pradesh | 2387 | 5918 | 9190 | 147.93 | 55.29 | 285.00 |
| West Bengal | 16 | 360 | 1508 | 2150.00 | 318.89 | 9325.00 |
| INDIA | 7430 | 18551 | 33917 | 149.68 | 82.83 | 356.49 |

State wise % Change in Groundwater Irrigated Area



State-wise & source-wise growth in irrigated area

- From 1960-1 to 2002-3
- From 1960-1 to 1980-1 (Green revolution phase I)
- From 1980-1 to 2002-3 (green revolution phase II)

Statewise Growth Rate in Canal Irrigated Area: 1960-1 to 2002-3

| | 1960-1 to 1980-1 | 1980-1 to 2002-3 | 1960-1 to 2002-3 |
|----------------|------------------|------------------|------------------|
| Andhra Pradesh | 1.65 | -0.91 | 0.57 |
| Bihar | 3.15 | -0.03 | 1.36 |
| Gujarat | 6.90 | 1.46 | 4.22 |
| Haryana | 0.87 | 1.07 | 1.20 |
| Karnataka | 4.02 | 2.24 | 3.22 |
| Kerala | -2.28 | -0.29 | -1.74 |
| Madhya Pradesh | 4.49 | 1.52 | 3.48 |
| Maharashtra | 3.82 | 0.88 | 3.76 |
| Orissa | 8.56 | 0.07 | 4.12 |
| Punjab | -2.46 | -1.07 | -0.92 |
| Rajasthan | 3.20 | 1.73 | 2.53 |
| Tamil Nadu | -1.30 | -0.35 | -0.25 |
| Uttar Pradesh | 2.18 | 0.50 | 1.02 |
| West Bengal | 0.39 | 1.17 | -1.22 |
| INDIA | 2.00 | 0.17 | 1.26 |

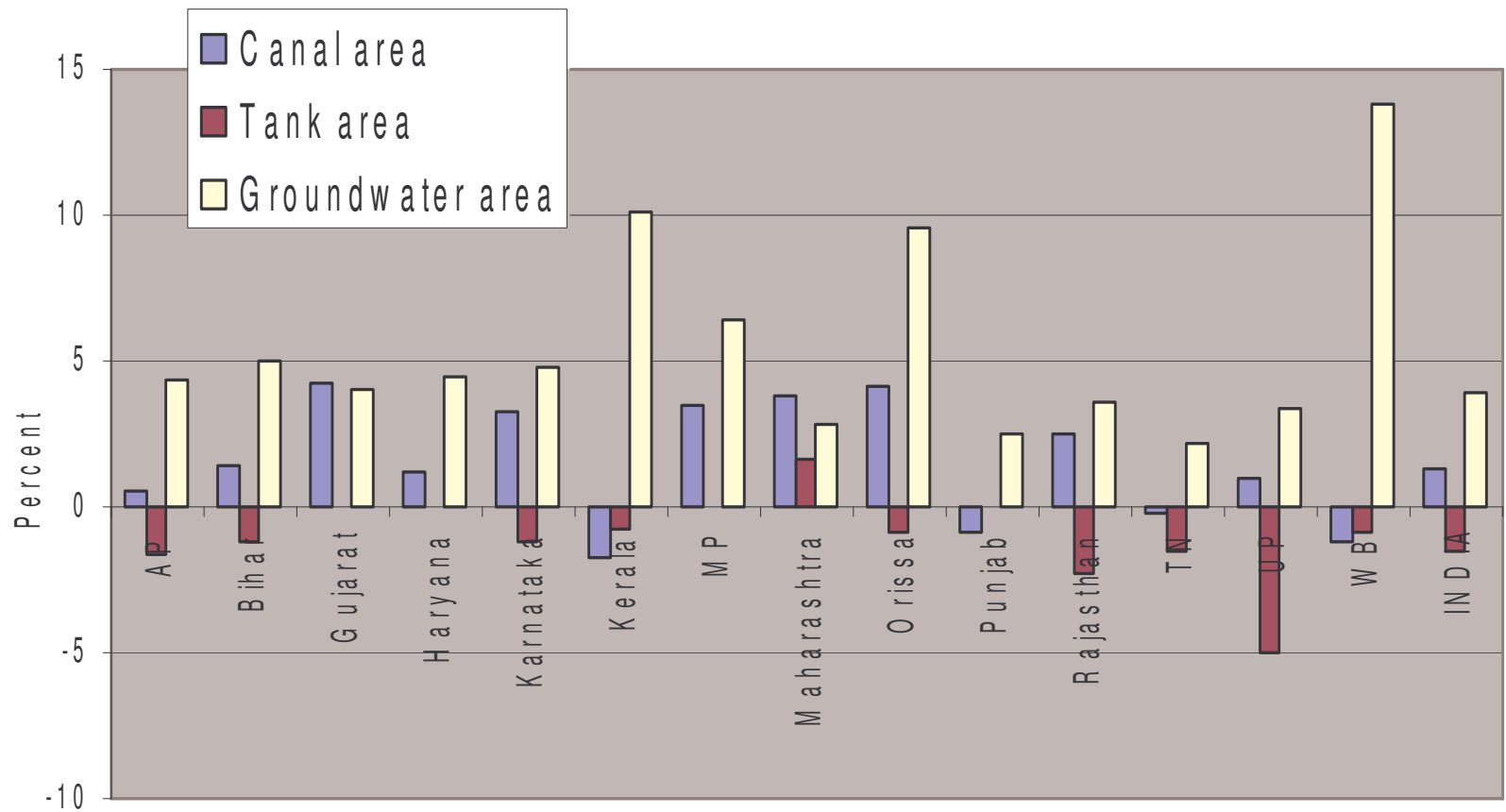
Statewise Growth Rate in Groundwater Irrigated Area:1960-1 to 2002-3

| | 1960-1 to 1980-1 | 1980-1 to 2002-3 | 1960-1 to 2002-3 |
|----------------|------------------|------------------|------------------|
| Andhra Pradesh | 3.82 | 4.88 | 4.34 |
| Bihar | 8.13 | 4.43 | 4.97 |
| Gujarat | 6.50 | 2.35 | 4.05 |
| Haryana | 7.36 | 1.87 | 4.44 |
| Karnataka | 5.23 | 4.78 | 4.83 |
| Kerala | 17.09 | -- | 10.11 |
| Madhya Pradesh | 6.18 | 6.41 | 6.36 |
| Maharashtra | 3.35 | 3.18 | 2.79 |
| Orissa | 9.47 | 1.88 | 9.54 |
| Punjab | 4.06 | 1.56 | 2.54 |
| Rajasthan | 3.24 | 4.22 | 3.55 |
| Tamil Nadu | 3.88 | 2.02 | 2.13 |
| Uttar Pradesh | 4.55 | 2.40 | 3.33 |
| West Bengal | 0.33 | 6.87 | 13.81 |
| INDIA | 4.95 | 4.25 | 3.90 |

Statewise Growth Rate in Tank Irrigated Area:1960-1 to 2002-3

| | 1960-1 to 1980-1 | 1980-1 to 2002-3 | 1960-1 to 2002-3 |
|----------------|------------------|------------------|------------------|
| Andhra Pradesh | -1.73 | -2.30 | -1.62 |
| Bihar | -5.26 | 1.93 | -1.23 |
| Gujarat | | | |
| Haryana | | | |
| Karnataka | -0.37 | -0.95 | -1.17 |
| Kerala | 0.53 | 0.15 | -0.75 |
| Madhya Pradesh | 0.19 | -1.44 | 0.02 |
| Maharashtra | 1.91 | 1.95 | 1.59 |
| Orissa | -4.72 | -0.09 | -0.89 |
| Punjab | | | |
| Rajasthan | 0.23 | -3.44 | -2.33 |
| Tamil Nadu | -1.16 | -0.58 | -1.47 |
| Uttar Pradesh | -3.91 | -4.11 | -5.05 |
| West Bengal | -0.68 | -1.16 | -0.90 |
| INDIA | -1.58 | -0.96 | -1.51 |

State wise and Source wise Growth of Irrigated Area: 1960-1 to 2002-3



Irrigation development and cropping intensity Nexus

- Correlation computed between irrigated area (by source) and CI

Correlation between CI and Irrigation Sources: 1960-1 to 2002-3

| States | Correlation value between CI and | | | | |
|------------------|----------------------------------|---------|--------|-------|--------|
| | NIA | GIA | Canal | GW | Tank |
| 1 Andhra Pradesh | 0.75 | .78 | .46 | .74 | -.49 |
| 2. Bihar | .74 | .74 | .59 | .75 | -.72 |
| 3. Gujarat | .60 | .63 | .69 | .93 | -- |
| 4. Haryana | .68 | .69 | .68 | .90 | -- |
| 5. Karnataka | .99 | .99 | .98 | .98 | -.81 |
| 6 Kerala | .11ns | -.001ns | -.14ns | .46 | .16ns |
| 7 Madhya Pradesh | .91 | .91 | .83 | .96 | .14ns |
| 8 Maharashtra | .93 | .95 | .77 | .92 | -- |
| 9 Orissa | .79 | .86 | .70 | .80 | -.22ns |
| 10 Punjab | .82 | .97 | -.55 | .95 | -- |
| 11 Rajasthan | .63 | .64 | .58 | .63 | -.18ns |
| 12 Tamil Nadu | .44 | .62 | .05ns | .15ns | .26ns |
| 13 Uttar Pradesh | .97 | .96 | .86 | .95 | -.97 |
| 14 West Bengal | .83 | .79 | -.77 | .89 | -.76 |
| INDIA | .99 | .99 | .91 | .99 | -.86 |

Major findings

- All easily possible potential has already been utilised in India – further expansion is very limited – over all 75% of potential.
- Growth in irrigated area (NIA & GIA) is better during first part of green revolution
- Tank area has been declining, whereas groundwater area has been increasing.
- Growth in canal area is insignificant during phase II of green revolution.
- Growth in irrigated area is low in agriculturally advanced states.
- Tank area has declined significantly in most of the states

Pointers for future

- Existing water use efficiency will have to be increased
- Gap between potential created and utilised needs to be reduced
- Special measures needed to revitalize the tank irrigation
- Micro-irrigation methods need to be adopted wherever possible

Thanks!